

2014 Gulf of Mexico Red Snapper Recreational Season Length Estimates
NOAA Fisheries Service
Southeast Regional Office
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Introduction

On October 1, 2013, NOAA Fisheries Service published a final rule ([Federal Register 57314, V. 78, No. 181](#)) implementing an 11 million pound whole weight (mp ww) total allowable catch for Gulf of Mexico red snapper. This catch level was the highest ever for red snapper and was allocated 51% to the commercial sector (5.61 mp ww) and 49% to the recreational sector (5.39 mp ww). The catch level is expected to remain at 11 mp through the 2014 season, but will be updated following the next stock assessment, which is scheduled for completion in winter 2014.

Under 50 CFR 22.34(b), the red snapper recreational fishing season opens each year on June 1 and closes when the recreational quota is met or projected to be reached. Prior to June 1 each year, NOAA Fisheries projects the season closing date based on the previous year's data, and notifies the public of the closing date for the upcoming season. If subsequent data indicate that the quota has not been reached by that closing date, NOAA Fisheries may re-open the season. NOAA Fisheries projected the 2013 recreational quota of 4.145 mp ww would be met by June 29, 2013.

Preliminary 2013 catch estimates produced by the Marine Recreational Information Program (MRIP) using a new dockside intercept sampling methodology were unexpectedly high relative to previous years, and indicated the private and for-hire components of the recreational sector landed 5.8 mp ww. Landings available through June 2013, including both MRIP and headboat landings, totaled 6.13 mp ww. Overall, the new MRIP catch estimates are more accurate and less biased than those produced in past years because MRIP redesigned the Access Point Angler Intercept Survey in March 2013 to provide better coverage of the variety of fishing trips ending at different times of day. Assuming the new survey methodology eliminated past biases, the new estimates might not be directly comparable to the 2013 quota or other red snapper management reference points, which were based on historical catch estimates using years of data and the prior methodology.

At this time, NOAA Fisheries does not have a sufficient understanding of how to use the 2013 MRIP landing estimates without better understanding how they fit into the broader scientific basis for red snapper management, which includes the stock assessment and the full historical times series of fishery data. Evaluations will be conducted prior to the 2014 stock assessment to better understand the relative contribution of the methodology change versus true shifts in angler behavior and landings to the unexpectedly high estimates for this year.

The purpose of this report is to project the length of the 2014 recreational red snapper season length. The projection methodology used to set the season length was previously certified by the Southeast Fisheries Science Center (SEFSC) in determining when landings would reach the quota during the 28-day summer fishing season and additional 14-day fall reopening. This report builds upon the 2013 projections by providing both a retrospective analysis of season-length projections and projected 2014 federal season-length estimates for Gulf of Mexico recreational red snapper. Analyses account for a variety of projection scenarios by incorporating uncertainty in the historical time series. When possible, data for 2013 are used to inform projections.

State Regulations

Texas has maintained a year-round state waters red snapper season, 4-fish bag limit, and 15-inch total length minimum size limit for numerous years. In 2012, the Louisiana Wildlife and Fisheries Commission voted to establish regulations that allow harvest in state waters on three-day weekends from the Saturday before Palm Sunday through September 30 and to increase the bag limit to three red snapper per person in state waters. Assuming Louisiana adopts similar regulations for 2014, their season would be open on three-day weekends between April 12 to September 30, 2014. In 2013, Florida set a 44-day state waters fishing season that began June 1 and ended on July 14. Florida reopened October 1 through October 21, seven days longer than the fall federal season (Oct 1-14). This analysis assumes Florida, Alabama, and Mississippi will implement regulations consistent with the federal season implemented by NOAA Fisheries (**Table 1**).

Table 1. Assumed Gulf state recreational red snapper regulations for 2014. Cells highlighted in gray indicate regulations incompatible with 2013 federal regulations.

State	Size Limit	Bag Limit	Season	Days Open
Florida*	16" TL	2-fish	Same as federal season	Same as federal season
Alabama	16" TL	2-fish	Same as federal season	Same as federal season
Mississippi	16" TL	2-fish	Same as federal season	Same as federal season
Louisiana	16" TL	3-fish	Apr 12-Sept 30 (3-day weekends)	76 + weekdays (M-Th) during federal season
Texas	15" TL	4-fish	Jan 1-Dec 31	365

Data Sources

Recreational red snapper landings were obtained from four data sources:

1. Marine Recreational Information Program (MRIP), including the For-hire charter survey;
2. Southeast Fisheries Science Center Headboat survey (HBS);
3. Louisiana Department of Wildlife and Fisheries (LDWF) Louisiana Recreational Creel survey (LA Creel); and,
4. Texas Parks and Wildlife Department (TPWD) charter and private/rental creel survey.

MRIP and For-hire red snapper landings are estimated using a combination of dockside intercepts (landings data) and phone surveys (effort data). Landings are estimated in both numbers and whole weight (lbs) by two-month wave (e.g., Wave 1 = Jan/Feb, ..., Wave 6 = Nov/Dec), area fished (inland, state, and federal waters), mode of fishing (charter, private/rental, shore), and state (west Florida, Alabama, Mississippi, and Louisiana). MRIP has replaced the Marine Recreational Fisheries Statistics Survey (MRFSS) program as the primary methodology for collecting and estimating recreational catches in the Gulf of Mexico. MRIP is a more scientifically sound method for estimating catch and includes new procedures for conducting dockside intercepts and new statistical methods for estimating catch. Additionally, new sampling methodologies for collecting effort data have been tested through MRIP pilot studies and will allow for anglers to be directly contacted to collect effort data. Due to concerns regarding MRIP data collected under the new intercept methodology during Wave 3, 2013 (discussed above), the 2013 MRIP landings data were used only for sensitivity runs.

Headboat landings are collected through logbooks completed by headboat operators. Landings (lbs ww) are reported by vessel, day/month, and statistical reporting area (i.e., area 18 = Dry Tortugas off west coast of Florida, ..., area 27 = Southeast Texas). Landings from vessels participating in the 2014 Headboat Collaborative Exempted Fishing Permit were deducted from the projection inputs, and their harvest was also deducted from the overall recreational quota (http://sero.nmfs.noaa.gov/sustainable_fisheries/gulf_fisheries/reef_fish/2013/headboat_efp/).

Louisiana's quota monitoring survey was designed to estimate the number of red snapper landed in Louisiana during the 2013 recreational season. Dockside interviews were conducted by state personnel at sites commonly reporting offshore species. To estimate fishing effort of private anglers, LDWF personnel contacted a random portion of those anglers holding a Louisiana Recreational Offshore Landing Permit by phone and/or email on a weekly basis. Permit holders were asked if they fished offshore, how many trips were taken the previous week, if they landed at a public site, what time they returned to the dock, and whether they fished on a paid charter. The randomly selected permit holders were notified by e-mail each Wednesday of their selection to be surveyed. Those selected permit holders had the option to answer the effort survey questions by reply e-mail. If an e-mail was not received, they were contacted by phone. Charter captains holding a Louisiana Recreational Offshore Landing Permit were also contacted by LDWF weekly to collect information on the total number of red snapper caught the previous week. Charter captains had the option to respond via email prior to LDWF personnel contacting them via phone. Estimated landings were produced based on observed catch rates, average weights, and estimated fishing effort (as adjusted for persons not possessing an offshore landing permit).

The TPWD creel survey generates estimates of landings in numbers for private/rental boats and charter vessels fishing off Texas. Landings are reported in numbers by high (May 15-November 20) and low-use time periods (November 21-May 14), area fished (state vs. federal waters), and mode of fishing (private vs. charter). To convert TPWD landings in numbers to landings in

pounds, red snapper average lengths by mode, wave, and area fished are converted to weights using length-weight conversion formula.

At this time, preliminary MRIP landings are available through August 2013, LA Creel survey landings are available through October (Mar-Oct 2013), preliminary Headboat landings are available from January 1-August 31, 2013, and TPWD landings are available through mid-May 2013.

Methods

Retrospective Analysis

Historical Gulf of Mexico red snapper harvest data 2009-2012 were obtained from the SEFSC recreational annual catch limit (ACL) database. MRFSS-based private/charter, SEFSC headboat survey, and TPWD creel survey data. MRFSS-based private/charter data were used for the retrospective analysis because quotas in 2009-2012 were based on assessments with MRFSS-based recreational catch inputs. The years 2009-2012 were chosen because 2009 was the first year recreational season projections were conducted in a manner similar to those summarized herein. In-season recreational catch rates for the entire Gulf of Mexico were computed, accounting for state incompatibility (**Table 2**). The number of federal days open was iteratively solved using Excel Solver (see SERO-LAPP-2013-02 Addendum), until the total landings exactly matched the quota (Equations 1-3).

$$\text{Inseason landings} = \text{Inseason CPD}(\text{lbs ww}) \times \text{fed days open} \quad (1)$$

$$\text{Out of season landings} = \text{Out of season CPD}(\text{lbs ww}) \times (\text{state days open} - \text{fed days open}) \quad (2)$$

$$\text{Inseason landings} + \text{Out of season landings} = \text{quota} \quad (3)$$

where CPD = catch per day (lbs ww).

Additionally, estimates of average weights from season length forecasts were compared to observed average weights. Optimal catch-rate and observed average weights were compared to sensitivity runs from previous quota closure analysis reports (SERO-LAPP-2009-02, SERO-LAPP-2011-03, SERO-LAPP-2012-01, SERO-LAPP-2012-10). No quota closure analysis reports were available prior to 2009.

Table 2. Actual MRFSS-based Gulf of Mexico red snapper recreational landings per day.

Year	In-Season Landings/day (n)	Out-of-Season Landings/day (n)	Federal Season (days)	Recreational Quota (lbs)
2009	11,761	116	75	2,450,000
2010		DWH oil spill		3,403,000
2011	14,471	85	48	3,865,000
2012	17,418	74	46	3,959,000

2014 Projections

A tiered projection approach was taken for forecasting recreational red snapper average weight and in-season catch rates in the Gulf of Mexico for 2014. Average weights and in-season catch rates were computed using the same methodology as 2013 projections (see SERO-LAPP-2013-02 Addendum). Ratios of landings per day were computed instead of modeling landings to account for shorter and shorter fishing seasons implemented in recent years. Since 2007, the recreational fishing season has decreased from 194 days to 42 days (2013 season length). Because the most recent red snapper stock assessment treated red snapper as separate Eastern and Western Gulf of Mexico stocks, and because the Eastern and Western Gulf states have differing data collection programs, average weights and catch rates were projected separately for the Eastern and Western Gulf of Mexico. Headboat 2013 data were considered complete and reliable for projection purposes, whereas TPWD 2013 Private/Charter data were not yet complete and intercept survey design changes affected MRIP 2013 Private/Charter data. Different projections were done for Headboat and the Private/Charter sectors to account for differences in the availability and completeness of data. This differed from previous projections, which aggregated data across Headboat and Private/Charter sectors. Generalized linear regression models were implemented using SAS (Proc Genmod, SAS Institute, Inc., Cary, NC).

Several different regression time periods were evaluated: 1) 2005-2013 [rebuilding plan revised in 2005]; 2) 2007-2013 [interim measures to end overfishing implemented in 2007]; and, 3) 2009-2013 [most recent years]. Under all scenarios, 2010 was dropped, due to the confounding effects of fishery closures due to the BP/Deep Water Horizon oil spill.

Due to lack of complete TPWD 2013 data and changes in the MRIP intercept methodology for 2013, several sensitivity runs for private/charter 2013 catch rates and average weights were conducted: 1) Omit 2013 data for private/charter [2-year forward projection]; 2) Include LA Creel survey 2013 and TPWD 2012 data for West; 3) Include MRIP 2013 data and TPWD 2012 data for East and West.

In all, nearly 100 sensitivity runs were performed, with each model scenario fit as follows:

- 1) Gaussian error distribution, using SEDAR-31 spawning stock biomass (SSB)
Projections for East and West as a covariate predictor (Fig. 1);
- 2) Gaussian error distribution, no covariate predictor;

- 3) Negative binomial error distribution, SEDAR-31 SSB Projections for East and West as a covariate predictor; and,
- 4) Negative binomial error distribution, no covariate predictor.

SSB, a proxy for exploitable abundance, was used as a covariate predictor. SSB was included to potentially account for changes in stock size (and corresponding availability) as the population rebuilds.

The best-fitting models for each of the model scenarios were identified based on significance of parameter terms, AICc (Burnham & Anderson 2002), BIC (Schwarz 1978), and R-square goodness of fit. Forecasts of catch rates and average weights from best-fitting models were then incorporated, along with their 95% confidence intervals, into an Excel-based season length projection model that utilized Solver to determine the federal season length under each scenario. This model accounted for out-of-season catch rates and state incompatibility with Federal season length. Out-of-season catch rates and average weights were computed for each state based on 2013 Headboat and LA Creel survey data and 2012 TPWD data.

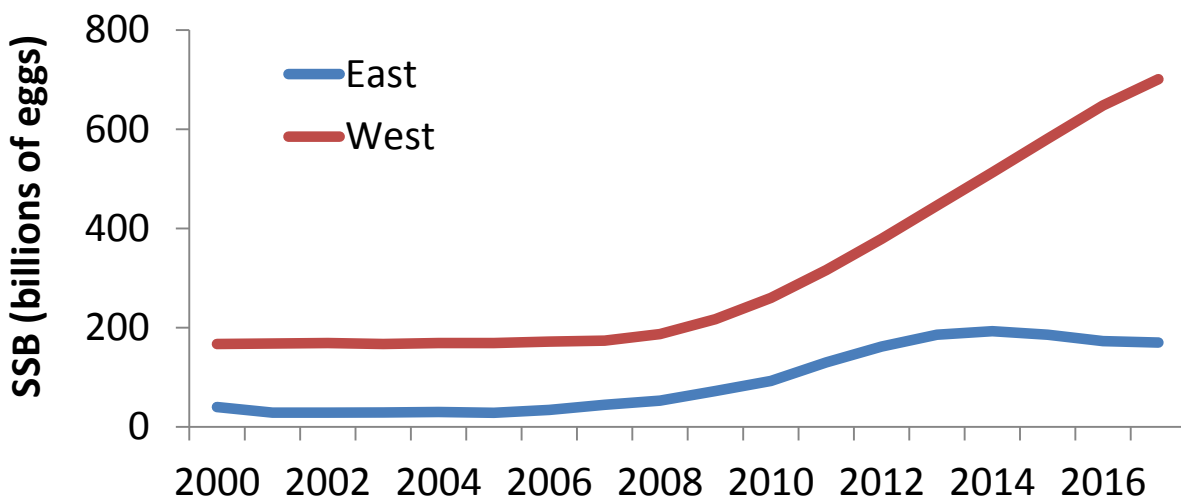


Figure 1. Spawning stock biomass (SSB) estimates, in billions of eggs, from SEDAR-31 (2013) stock assessment model for Eastern and Western Gulf of Mexico red snapper stock, used as covariate predictor variable for projections as a measure of underlying stock productivity.

Results

Retrospective Analysis

Retrospective analyses on forecast versus observed average weights indicated average weight of a landed red snapper was underestimated in 2009, 2011, and 2012 (Fig. 2). Accuracy of average weight forecasting has improved through time. Average weight was underestimated by 13%, 7% and 10% in 2009, 2011, and 2012, respectively. In 2013, average weight was overestimated by 3%. In 2009, average weights from 4.4 lbs (the observed average weight in

2008) to 5.28 lbs (the stock assessment projected average weight) were considered. The 2009 average weight was assumed to be equal to the 2008 average weight when setting the 2009 season length; however, the actual average weight was almost identical to one of the sensitivity runs at 5.06 lbs/fish. This observed average weight in 2009 was somewhat lower than the stock assessment's forecast average weight. The 2011 and 2012 observed average weights were slightly higher than any sensitivity runs considered and higher than the stock assessment's forecast average weight. The 2013 mean forecast for average weight was slightly higher than the observed average weight, but within the 95% confidence intervals.

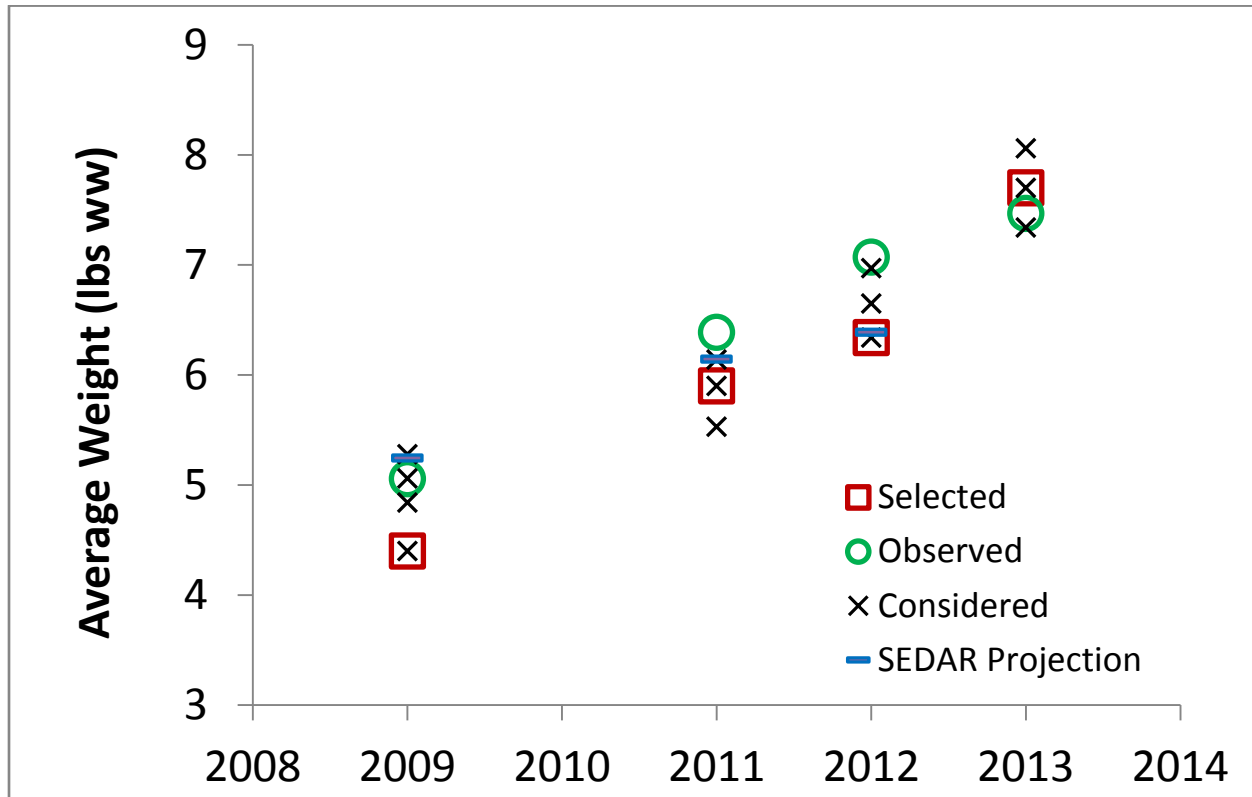


Figure 2. Observed average weights (green circles) for Gulf of Mexico recreational red snapper, relative to the average weight assumed for projecting the season length (red squares), sensitivity runs from previous projection models (x), and stock assessment projected average weight.

Retrospective analyses of forecasted catch rates versus observed catch rates indicated improvements in forecasting season lengths through time (Fig. 3). Since 2009, sensitivity runs have tended to encompass or nearly encompass the optimum season (i.e., the season length that would result in the quota being exactly met). In all years except 2010, the federal season length was projected to be longer than necessary to constrain harvest to the quota. In 2009, the run selected for the final season-length determination failed to account for increasing angler trips per federal day open. In 2011, a model incorporating increasing angler trips per day with an average weight 4% less than projected by the stock assessment correctly predicted the optimum season length of 39 days. However, the season selected for management (48 days)

assumed that angler trips per day were reaching an asymptote. In 2012, two projections were both close to the optimum season length (30 days). These projections predicted increasing catches and angler trips per day; however, the season length selection (40 days) was based on projection runs that significantly underestimated the average weight of fish caught. Given the previous performance of red snapper quota projection models, 2013 projections were revised to account for increasing landings and average weights per federal fishing day open. Unlike projections in 2011 and 2012, no scenarios were considered that assumed landings per day or fishing effort would asymptote. Results indicate predicted average weights were similar, although slightly higher than observed average weights. Predicted versus observed 2013 landings per day could not be directly compared because of changes to the MRIP intercept survey. Comparison of headboat landings from 2012 to 2013 indicated landings were 10% higher in terms of numbers of fish, but 14% lower in terms of pounds of fish. Projections for 2013 estimated the number of fish landed Gulfwide (all modes) would increase by 3%, while the poundage of fish landed Gulfwide would increase by 13%. The number of fish landed by headboats in 2013 was greater than 2013 Gulfwide projections, but the weight of fish landed by headboats in 2013 was considerably less than projected.

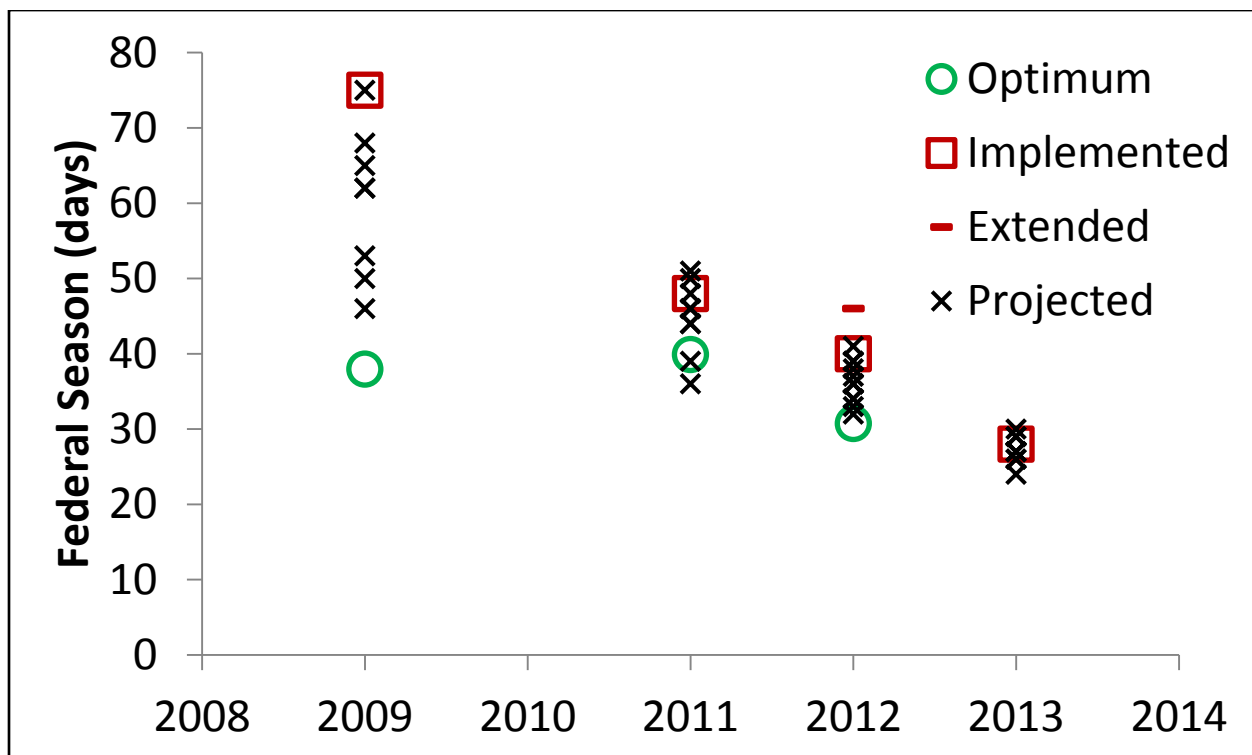


Figure 3. Optimal federal season length (green circles) that would result in the quota being exactly met, relative to federal season implemented each year (red squares) and projected season lengths from prior forecasting models (x). The 2012 recreational red snapper season was extended by 6-days. The red dashed line represents the length of the 2012 federal season originally implemented plus an additional 6 days. The season was extended due to a tropical storm that year.

2014 Projections

In all, 52 model runs were evaluated to project average weights for 2014 (Appendix 1), and 100 model runs were evaluated to project catch rates for 2014 (Appendix 2). Many model scenarios resulted in statistically defensible sensitivity runs while other runs failed to converge; the best-fitting models are discussed below. Model fits and assumptions for the model runs used to project the 2014 season length are highlighted in gray in Appendices 1 and 2.

In 2013, average weights for private/charter and headboat in the Eastern Gulf were 7.77 and 4.90 lbs ww, respectively, with 2011-2013 average headboat weights similarly 4.94 lbs ww. Projection models showed excellent fits to private/charter ($R^2=0.99$) and headboat ($R^2=0.93$) data in the Eastern Gulf of Mexico, with projected average weights for 2014 of 8.60 lbs ww and 5.75 lbs ww, respectively (Fig. 4: Top). In 2013, average weights for private/charter (including LA Survey 2013 data) and headboat in the Western Gulf were 7.94 and 5.48 lbs ww, respectively, with 2011-2013 average average weights at 7.64 and 6.60 lbs ww, respectively. Projection models showed a horizontal asymptotic fit to private/charter ($R^2=0.94$) and a dome-shaped fit to headboat ($R^2=0.77$) data in the Western Gulf using SSB as a predictor, with projected 2014 average weights of 7.59 lbs ww and 5.76 lbs ww, respectively (Fig. 4: Bottom).

In 2013, landings per federal day for private/charter and headboat in the Eastern Gulf were 10,581 and 1,212 fish/day, respectively. Projection models showed excellent fits to private/charter ($R^2=0.98$) and headboat ($R^2=0.86$) data in the Eastern Gulf of Mexico, with projected landings per day for 2014 of $11,371 \pm 192$ fish/day and $1,348 \pm 214$ fish/day, respectively (Fig. 5: Top). In 2013, catch rates for private/charter (including LA Survey 2013 data) and headboat in the Western Gulf were 1,593 and 1,022 fish/day, respectively. Projection models showed a poor fit to private/charter ($R^2=0.41$) and an excellent fit to headboat ($R^2=0.97$) data in the Western Gulf, with projected 2014 landings per day of 2,344 (95% CI: 1,611-3,411) fish/day and $1,123 \pm 82$ fish/day, respectively (Fig. 5: Bottom).

In general, the Eastern Gulf of Mexico model fits were the most statistically robust (lower AICc, lower BIC, and/or better r^2), and SSB was not useful as a predictor because the rate of change in SSB is slower in the Eastern Gulf and the trend in the stock is swamped by the rapidly increasing interannual trends in average weight. Model fits for the Western Gulf of Mexico private/charter catch rate were the least robust due to the low 2011 landings per day estimate followed by the high 2012 landings per day estimate. Several sensitivity runs were performed to evaluate the influence of changes in Western Gulf of Mexico landings per day on season length.

To encompass the uncertainty inherent in projection modeling, ten models were selected to estimate the 2014 federal season length (Table 3). These models incorporated 1) upper/lower confidence limits of landings per day; 2) upper/lower confidence limits of average weights; 3) recent average weights (2011-13 or 2013 only); and 4) 2013 LA Creel survey landings per day and average weights. Model estimates ranged from 33-44 days, with a median of 40 days.

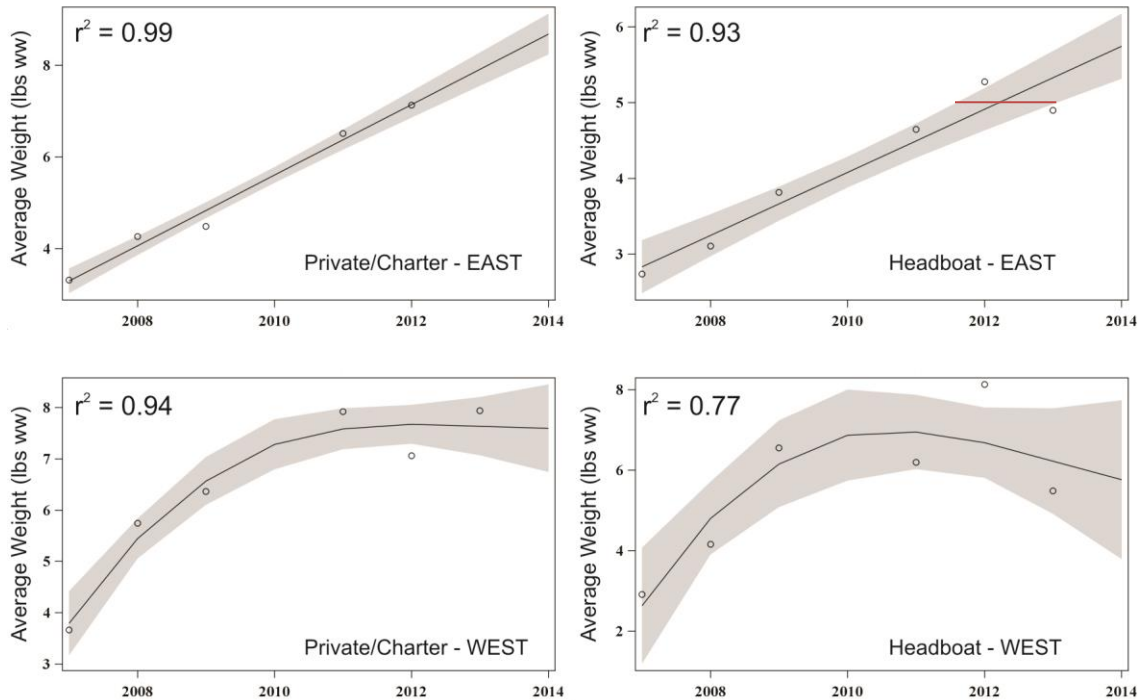


Figure 4. Projected average weights in the Eastern (top) and Western (bottom) Gulf of Mexico for Private/Charter (includes MRIP in Eastern Gulf, MRIP + TPWD + LA Creel survey in Western Gulf) and Headboat sectors, with 95% confidence limits and 3-year average (red bar).

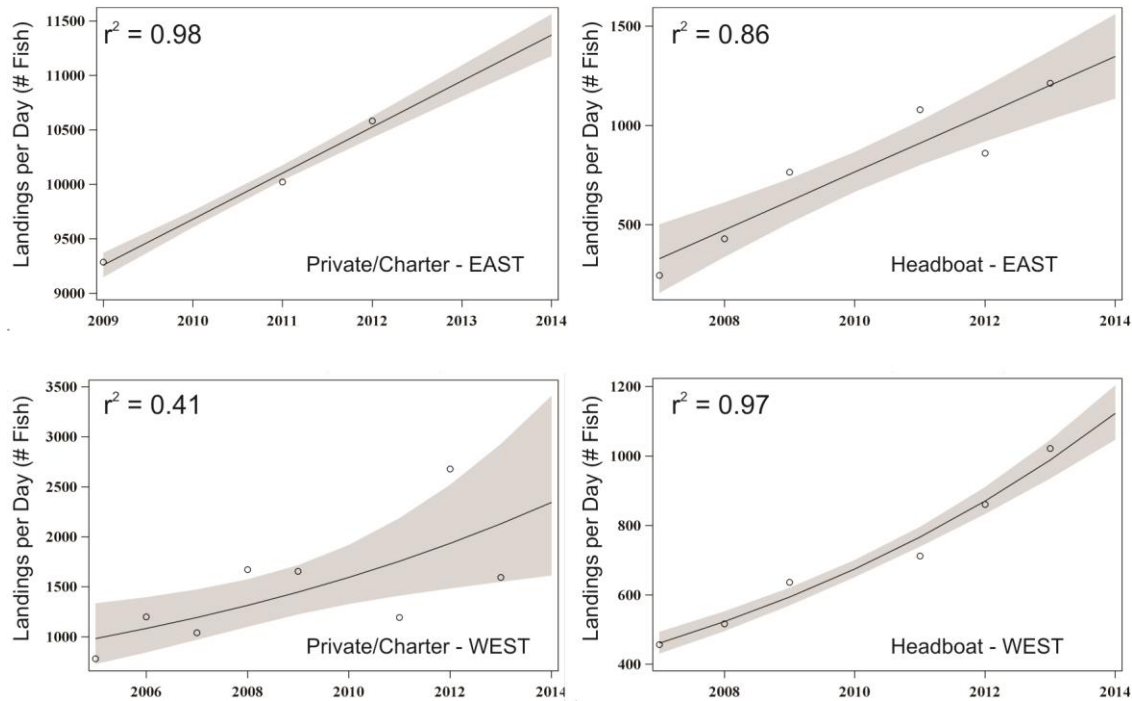


Figure 5. Projected landings per day (numbers) in the Eastern (top) and Western (bottom) Gulf of Mexico for Private/Charter (includes MRIP in Eastern Gulf, MRIP + TPWD + LA Creel survey in Western Gulf (2013 only)) and Headboat sectors, with 95% confidence bands.

Table 3. Gulf of Mexico red snapper federal season length (days) under ten projection scenarios.

Run	Projection Description	Season Length
1	Projected mean catch rates and average weights	38
2	Run 1, except 2013 LA survey and 2012 TPWD catch rates and average weights used	40
3	Run 1 catch rates and LCL average weights	41
4	Run 1 catch rates and UCL average weights	36
5	Run 1 average weights and LCL catch rates	41
6	Run 1 average weights and UCL catch rates	35
7	LCL catch rates and LCL average weights	44
8	UCL catch rates and UCL average weights	33
9	Run 1 catch rates and 2011-13 avg wgts (except MRIP east)	40
10	Run 1 catch rates and 2013 avg wgts	41

Discussion

Restrospective analyses indicate improvements in projection methodologies have occurred over time. Average weight estimates were historically underestimated, but in 2013 projected and observed average weights were within 3% of one another, and well within the range of average weights considered for projections. Similarly, estimates of season length improved from 2009 through 2012 with season estimates at or near the lower end of the range season lengths projected. Past overages have occurred for a variety of reasons, including challenges with predicting angler behavior and landing rates, inconsistent state regulations, and rapidly increasing fish sizes. As a result projection assumptions in more recent years, including this analysis, have been refined to better account for increases in landings per day and changes in average weights.

As with any projection model, the approaches discussed herein are dependent upon assumptions that historical data are accurately estimated and that historical trends are representative of future dynamics. Previous evaluations of Gulf of Mexico recreational red snapper catch rates have indicated that effort compression (i.e., fishing pressure intensifies during open days as the season shortens) is occurring in the fishery (SERO-LAPP-2012-01). These dynamics are implicitly incorporated into the generalized linear regression approaches described by this document. Additionally, the red snapper stock is recovering, leading to changes in abundance and age structure of the exploited stock. This dynamic is explicitly incorporated into our regression approaches as the highly-correlated predictive covariate, SSB. By separating projections by mode of fishing (headboat vs. private/charter) and stock unit (Eastern vs. Western Gulf), inherent differences in rates of fishing and stock recovery between these modes and areas are made more explicit, which may continue the trend towards improved forecasting methods revealed by our retrospective analysis.

Estimating the red snapper season for 2014 is additionally complicated due to the substantial changes that took place in 2013, with several states adopting incompatible regulations and MRIP substantially modifying their sampling methodology. These changes make it difficult to ascertain whether the quota was exceeded in 2013, whether the quota is accurately specified to be consistent with the new MRIP methodology, what impacts shifting more harvest into state waters in 2013 will have upon catch rates and average weights in 2014.

Setting the season length based on shorter season estimates will reduce the risk of a quota overage (assuming states do not decide to adopt inconsistent regulations), but increases the likelihood the quota may not be harvested. Based on the analyses presented herein, the federal season length is estimated to range from 33 to 44 days in 2014. The average season length predicted by all model runs was 39 days (± 2 days) and the median season length for all projections was 40 days.

References

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Appendix 1. Relevant statistics for model selection for generalized linear projection models of Gulf of Mexico recreational red snapper average weights in 2014. Models selected for predicting 2014 average weights are highlighted in gray.

Region	Mode	Input	years	Projected	L95%	U95%	2*LL	R-Square	BIC	AICC	Distribution fit	Predictor?	terms significant?
WEST	MRIP	HB2013	2007-2013	6.58527	5.32024	7.8503	-10.6332	0.9593	8.247		normal	yes	yes
WEST	MRIP	HB2013	2007-2013	9.2633	7.62081	10.9058	-10.6332	0.7623	15.4615		normal	no	yes
WEST	MRIP	HB2013	2007-2013			FAILED CONVERGE					neg binomial	yes	
WEST	MRIP	HB2013	2007-2013			FAILED CONVERGE					neg binomial	no	
EAST	MRIP	HB2013	2007-2013								normal	yes	NO
EAST	MRIP	HB2013	2007-2013	8.679	8.2329	9.125	2.4023	0.9825			normal	no	yes
EAST	MRIP	HB2013	2007-2013			FAILED CONVERGE					neg binomial	yes	
EAST	MRIP	HB2013	2007-2013			FAILED CONVERGE					neg binomial	no	
WEST	HB	HB2013	2007-2013	5.75819	3.78157	7.73481	-19.1907	0.7725	21.5504	62.3834	normal	yes	yes
WEST	HB	HB2013	2007-2013	7.75679	5.88753	10.7196	-19.1907	0.4931	24.566	37.1907	normal	no	
WEST	HB	HB2013	2007-2013			FAILED CONVERGE					neg binomial	yes	
WEST	HB	HB2013	2007-2013			FAILED CONVERGE					neg binomial	no	
EAST	HB	HB2013	2007-2013								normal	yes	NO
EAST	HB	HB2013	2007-2013	5.74547	5.3145	6.17644	-0.6736	0.9251	6.0489	18.6736	normal	no	
EAST	HB	HB2013	2007-2013			FAILED CONVERGE					neg binomial	yes	
EAST	HB	HB2013	2007-2013			FAILED CONVERGE					neg binomial	no	
WEST	MRIP	HB2013+LASURVEY	2007-2013	7.59427	6.73955	8.44898	-12.1741	0.9444	11.4899	52.3228	normal	yes	yes
WEST	MRIP	HB2013+LASURVEY	2007-2013	8.8758	7.75204	9.995	-12.1741	0.7942	17.5494	30.1741	normal	no	yes
WEST	MRIP	HB2013+LASURVEY	2007-2013			FAILED CONVERGE					neg binomial	yes	
WEST	MRIP	HB2013+LASURVEY	2007-2013			FAILED CONVERGE					neg binomial	no	
WEST	MRIP	HB2013+MRIP2013	2005-2013						25.766	38.7815	normal	yes	NO
WEST	MRIP	HB2013+MRIP2013	2005-2013	8.16997	6.97136	9.3686	-19.316	0.7381	25.5543	31.316	normal	no	yes
WEST	MRIP	HB2013+MRIP2013	2005-2013			FAILED CONVERGE					neg binomial	yes	
WEST	MRIP	HB2013+MRIP2013	2005-2013			FAILED CONVERGE					neg binomial	no	
EAST	MRIP	HB2013+MRIP2013	2005-2013								normal	yes	NO
EAST	MRIP	HB2013+MRIP2013	2005-2013	8.0769	7.3129	8.8409	-12.1103	0.9047	18.3487	24.1103	normal	no	yes
EAST	MRIP	HB2013+MRIP2013	2005-2013			FAILED CONVERGE					neg binomial	yes	
EAST	MRIP	HB2013+MRIP2013	2005-2013			FAILED CONVERGE					neg binomial	no	
WEST	HB	HB2013	2007-2013; DROP 2010-2011	5.71451	3.8048	7.62421	-16.8999	0.8183	18.0725	failed	normal	yes	yes
WEST	HB	HB2013	2007-2013; DROP 2010-2011	7.72809	5.34708	10.1091	-16.8999	0.4793	21.7282	46.8999	normal	no	yes
WEST	HB	HB2013	2007-2013; DROP 2010-2011			FAILED CONVERGE					neg binomial	yes	
WEST	HB	HB2013	2007-2013; DROP 2010-2011			FAILED CONVERGE					neg binomial	no	
WEST	MRIP	HB2013	2007-2013; DROP 2010-2011	6.37549	5.6248	7.12619	-8.009	0.9821	2.7031		normal	yes	yes
WEST	MRIP	HB2013	2007-2013; DROP 2010-2011	8.6027	6.76129	10.4441	-8.009	0.73	12.1678		normal	no	
WEST	MRIP	HB2013	2007-2013; DROP 2010-2011								neg binomial	yes	
WEST	MRIP	HB2013	2007-2013; DROP 2010-2011								neg binomial	no	
WEST	MRIP	HB2013+MRIP2013	2007-2013	6.24425	5.56589	6.92262	-15.2593	0.9567	8.7169	49.5498	normal	yes	yes
WEST	MRIP	HB2013+MRIP2013	2007-2013	8.08279	6.62961	9.536	-15.2593	0.5745	20.6346	33.2593	normal	no	yes
WEST	MRIP	HB2013+MRIP2013	2007-2013			FAILED CONVERGE					neg binomial	yes	
WEST	MRIP	HB2013+MRIP2013	2007-2013			FAILED CONVERGE					neg binomial	no	
EAST	MRIP	HB2013+MRIP2013	2007-2013								normal	yes	NO
EAST	MRIP	HB2013+MRIP2013	2007-2013	8.5966	8.2963	8.897	3.6608	0.9882	1.7145	14.3392	normal	no	
EAST	MRIP	HB2013+MRIP2013	2007-2013			FAILED CONVERGE					neg binomial	yes	
EAST	MRIP	HB2013+MRIP2013	2007-2013			FAILED CONVERGE					neg binomial	no	
WEST	HB	HB2013+MRIP2013	2007-2013	5.75819	3.78157	7.73481	-19.1907	0.7725	21.5504	62.3834	normal	yes	yes
WEST	HB	HB2013+MRIP2013	2007-2013	7.75679	5.74027	9.7733	-19.1907	0.4931	24.566	37.1907	normal	no	
WEST	HB	HB2013+MRIP2013	2007-2013			FAILED CONVERGE					neg binomial	yes	
WEST	HB	HB2013+MRIP2013	2007-2013			FAILED CONVERGE					neg binomial	no	
EAST	HB	HB2013+MRIP2013	2007-2013								normal	yes	NO
EAST	HB	HB2013+MRIP2013	2007-2013	5.74547	5.3145	6.17644	-16.2232	0.9251	6.0489	18.6736	normal	no	
EAST	HB	HB2013+MRIP2013	2007-2013			FAILED CONVERGE					neg binomial	yes	
EAST	HB	HB2013+MRIP2013	2007-2013			FAILED CONVERGE					neg binomial	no	

Appendix 2. Relevant statistics for model selection for generalized linear projection models of Gulf of Mexico recreational red snapper catch rates in 2014. Models selected for predicting 2014 landings per day are highlighted in gray.

Region	Mode	Input	years	Projected	L95%	U95%	2*LL	R-Square	BIC	AICC	Distribution fit	Predictor?	terms significant?
WEST	MRIP	HB2013	2007-2013								normal	yes	NO
WEST	MRIP	HB2013	2007-2013								normal	no	NO
WEST	MRIP	HB2013	2007-2013	FAILED TO CONVERGE							neg binomial	yes	
WEST	MRIP	HB2013	2007-2013								neg binomial	no	NO
EAST	MRIP	HB2013	2007-2013	13837.81	13049.2	14626.4	-78.8165	0.9768	77.4275	failed	normal	yes	yes
EAST	MRIP	HB2013	2007-2013					0.8888	83.6448		normal	no	yes
EAST	MRIP	HB2013	2007-2013	FAILED TO CONVERGE							neg binomial	yes	
EAST	MRIP	HB2013	2007-2013					0.842	85.8621		neg binomial	no	yes
WEST	HB	HB2013	2007-2013						66.7504	107.583	normal	yes	NO
WEST	HB	HB2013	2007-2013	1051.83	981.73	1121.92	-61.7726	0.9541	67.1479	79.7726	normal	no	yes
WEST	HB	HB2013	2007-2013	FAILED TO CONVERGE							neg binomial	yes	
WEST	HB	HB2013	2007-2013	1122.91	1046.73	1204.63	46982.45	0.9738	63.2431	75.8679	neg binomial	no	yes
EAST	HB	HB2013	2007-2013	1522.16	1293.58	1750.73	-75.1566	0.9198	78.9818	119.815	normal	yes	yes
EAST	HB	HB2013	2007-2013	1348.01	1134.18	1561.85	-75.1566	0.8601	80.5319	93.1566	normal	no	yes
EAST	HB	HB2013	2007-2013	FAILED TO CONVERGE							neg binomial	yes	
EAST	HB	HB2013	2007-2013					0.7814	83.4999	96.1246	neg binomial	no	yes
WEST	MRIP	HB2013+LASURVEY	2005-2013						126.774	139.789	normal	yes	NO
WEST	MRIP	HB2013+LASURVEY	2005-2013	2155.04	1551.77	2758.3	-118.855	0.4384	125.093	130.855	normal	no	yes
WEST	MRIP	HB2013+LASURVEY	2005-2013	FAILED TO CONVERGE							neg binomial	yes	
WEST	MRIP	HB2013+LASURVEY	2005-2013	2344.25	1611.01	3411.23	150071.9	0.4104	122.397	128.158	neg binomial	no	yes
WEST	MRIP	HB2013+MRIP2013	2005-2013				-116.875		124.967	137.982	normal	yes	NO
WEST	MRIP	HB2013+MRIP2013	2005-2013	2605.66	2072.61	3138.71	-116.875	0.6899	123.114	128.875	normal	no	yes
WEST	MRIP	HB2013+MRIP2013	2005-2013	FAILED TO CONVERGE							neg binomial	yes	
WEST	MRIP	HB2013+MRIP2013	2005-2013	2866.9	2084.44	3943.08	164262.8	0.705	121.052	126.814	neg binomial	no	yes
EAST	MRIP	HB2013+MRIP2013	2005-2013						159.162	164.923	normal	yes	NO
EAST	MRIP	HB2013+MRIP2013	2005-2013	19367.28	14294.6	24440	-152.923	0.7048			normal	no	yes
EAST	MRIP	HB2013+MRIP2013	2005-2013	FAILED TO CONVERGE							neg binomial	yes	
EAST	MRIP	HB2013+MRIP2013	2005-2013	22921.37	17511.3	30002.9	1249454	0.8021	145.423	151.184	neg binomial	no	yes
WEST	HB	HB2013+MRIP2013	2005-2013						87.7967	100.812	normal	yes	NO
WEST	HB	HB2013+MRIP2013	2005-2013	992.06	897.63	1086.5	-89.1835	0.8922	95.4218	101.184	normal	no	yes
WEST	HB	HB2013+MRIP2013	2005-2013	FAILED TO CONVERGE							neg binomial	yes	
WEST	HB	HB2013+MRIP2013	2005-2013	1044.56	935.44	1166.42	56925.15	0.9396	91.1126	96.8743	neg binomial	no	yes
EAST	HB	HB2013+MRIP2013	2005-2013						105.071	110.833	normal	yes	NO
EAST	HB	HB2013+MRIP2013	2005-2013	1315.36	1142.76	1487.96	-98.8328	0.9087			normal	no	yes
EAST	HB	HB2013+MRIP2013	2005-2013	FAILED TO CONVERGE							neg binomial	yes	
EAST	HB	HB2013+MRIP2013	2005-2013	1882.15	1325.15	2673.28	55954.52	0.8422	104.45	110.212	neg binomial	no	
WEST	HB	HB2013	2007-2013; DROP 2010-2011	1100.36	1044.24	1156.49	-46.312	0.9885	51.8786	failed	normal	yes	yes
WEST	HB	HB2013	2007-2013; DROP 2010-2011	1081.47	1036.37	1126.56	-46.312	0.9864	51.1403	76.312	normal	no	yes
WEST	HB	HB2013	2007-2013; DROP 2010-2011	FAILED TO CONVERGE							neg binomial	yes	
WEST	HB	HB2013	2007-2013; DROP 2010-2011	1148.28	1081.06	1219.68	39058.28	0.9902	49.7901	74.9617	neg binomial	no	
WEST	MRIP	HB2013	2007-2013; DROP 2010-2011								normal	yes	NO
WEST	MRIP	HB2013	2007-2013; DROP 2010-2011	3290.37	2919.12	3661.61	-50.4596	0.949	54.6185		normal	no	yes
WEST	MRIP	HB2013	2007-2013; DROP 2010-2011	FAILED TO CONVERGE							neg binomial	yes	
WEST	MRIP	HB2013	2007-2013; DROP 2010-2011	3845.86	2818.39	5247.9	91906.75	0.9326	57.2489		neg binomial	no	yes
WEST	MRIP	HB2013	2005-2013								normal	yes	NO
WEST	MRIP	HB2013	2005-2013	2509.43	1774.73	3244.12	-103.042	0.5684	108.88	117.042	normal	no	yes
WEST	MRIP	HB2013	2005-2013	FAILED TO CONVERGE							neg binomial	yes	
WEST	MRIP	HB2013	2005-2013	2869.86	1835.89	4486.16	129767.3	0.5801	106.163	114.326	neg binomial	no	yes
EAST	MRIP	HB2013	2005-2013	13104.27	12129	14079.5	-109.859	0.965	114.429	134.645	normal	yes	yes
EAST	MRIP	HB2013	2005-2013	13329.99	12134.5	14525.5	-109.859	0.9446	115.696	123.859	normal	no	
EAST	MRIP	HB2013	2005-2013	FAILED TO CONVERGE							neg binomial	yes	
EAST	MRIP	HB2013	2005-2013						118.957	127.119	neg binomial	no	
WEST	HB	HB2013	2005-2013							100.812	normal	yes	NO
WEST	HB	HB2013	2005-2013	992.06	897.63	1086.5	-89.1835	0.8922	95.4218	101.184	normal	no	yes
WEST	HB	HB2013	2005-2013	FAILED TO CONVERGE							neg binomial	yes	
WEST	HB	HB2013	2005-2013	1044.56	935.44	1166.42	56925.15	0.9396	91.1126	96.8743	neg binomial	no	yes
EAST	HB	HB2013	2005-2013								normal	yes	NO

Region	Mode	Input	years	Projected	L95%	U95%	2*LL	R-Square	BIC	AICC	Distribution fit	Predictor?	terms significant?
EAST	HB	HB2013	2005-2013	1315.36	1142.76	1487.96	-98.8328	0.9087	105.071	110.833	normal	no	yes
EAST	HB	HB2013	2005-2013				FAILED TO CONVERGE				neg binomial	yes	
EAST	HB	HB2013	2005-2013	1882.15	1325.15	2673.28	55954.52	0.8422	104.45	110.212	neg binomial	no	yes
EAST	MRIP	HB2013	2009-2013	9709.64	9677.95	9741.34	10667.72	1	8.8095	failed	normal	yes	sort of; pred1 slope = 0
EAST	MRIP	HB2013	2009-2013	11371.06	11178.5	11563.6	-33.0427	0.9874	36.3386	failed	normal	no	yes
EAST	MRIP	HB2013	2009-2013				FAILED TO CONVERGE				neg binomial	yes	
EAST	MRIP	HB2013	2009-2013				FAILED TO CONVERGE				neg binomial	no	
EAST	HB	HB2013	2009-2013	2621.65	1851.67	3391.62	-49.4968	0.8951	49.2602		normal	yes	yes
EAST	HB	HB2013	2009-2013	1223.35	979.83	1466.87	-49.4968	0.5547	53.6557		normal	no	yes
EAST	HB	HB2013	2009-2013								neg binomial	yes	
EAST	HB	HB2013	2009-2013	1255.79	983.61	1603.28	46221.3	0.5587	53.4017		neg binomial	no	
WEST	MRIP	HB2013+LASURVEY	2007-2013								normal	yes	NO
WEST	MRIP	HB2013+LASURVEY	2007-2013								normal	no	NO
WEST	MRIP	HB2013+LASURVEY	2007-2013				FAILED TO CONVERGE				neg binomial	yes	
WEST	MRIP	HB2013+LASURVEY	2007-2013								neg binomial	no	NO
WEST	HB	HB2013+LASURVEY	2007-2013								normal	yes	NO
WEST	HB	HB2013+LASURVEY	2007-2013	1051.83	981.73	1121.92	-61.7726	0.9541	67.1479	79.7726	normal	no	yes
WEST	HB	HB2013+LASURVEY	2007-2013								neg binomial	yes	
WEST	HB	HB2013+LASURVEY	2007-2013	1122.91	1046.73	1204.63	46982.45	0.9738	63.2431	75.8679	neg binomial	no	yes
WEST	MRIP	HB2013+MRIP2013	2007-2013								normal	yes	NO
WEST	MRIP	HB2013+MRIP2013	2007-2013	2651.08	1965.96	3336.19	-89.1293	0.5648	94.5045	107.129	normal	no	
WEST	MRIP	HB2013+MRIP2013	2007-2013				FAILED TO CONVERGE				neg binomial	yes	
WEST	MRIP	HB2013+MRIP2013	2007-2013	2795.5	1900.74	4111.46	140887.1	0.5862	94.0694	106.694	neg binomial	no	yes
EAST	MRIP	HB2013+MRIP2013	2007-2013								normal	yes	NO
EAST	MRIP	HB2013+MRIP2013	2007-2013	20551.46	14215.9	26887	-115.821	0.6435	121.197	133.821	normal	no	yes
EAST	MRIP	HB2013+MRIP2013	2007-2013								neg binomial	yes	
EAST	MRIP	HB2013+MRIP2013	2007-2013	22746.41	16134.3	32068.4	1135641	0.7377	114.107	126.732	neg binomial	no	yes
WEST	HB	HB2013+MRIP2013	2007-2013								normal	yes	NO
WEST	HB	HB2013+MRIP2013	2007-2013	1051.83	981.73	1121.92	-61.7726	0.9541	67.1479	79.7726	normal	no	yes
WEST	HB	HB2013+MRIP2013	2007-2013				FAILED TO CONVERGE				neg binomial	yes	
WEST	HB	HB2013+MRIP2013	2007-2013	1122.91	1046.73	1204.63	46982.45	0.9738	63.2431	75.8679	neg binomial	no	yes
EAST	HB	HB2013+MRIP2013	2007-2013	1522.16	1293.58	1750.73	-75.1566	0.9198	78.9818	119.815	normal	yes	yes
EAST	HB	HB2013+MRIP2013	2007-2013	1348.01	1134.18	1561.85	-75.1566	0.8601	80.5319	93.1566	normal	no	yes
EAST	HB	HB2013+MRIP2013	2007-2013								neg binomial	yes	
EAST	HB	HB2013+MRIP2013	2007-2013						83.4999	96.1246	neg binomial	no	
WEST	HB	HB2013+LASURVEY	2007-2013; DROP 2010-2011				-45.4408		51.8786		normal	yes	NO
WEST	HB	HB2013+LASURVEY	2007-2013; DROP 2010-2011	1081.47	1036.37	1126.56	-46.312	0.9864	51.1403	76.312	normal	no	yes
WEST	HB	HB2013+LASURVEY	2007-2013; DROP 2010-2011								neg binomial	yes	
WEST	HB	HB2013+LASURVEY	2007-2013; DROP 2010-2011	1148.28	1081.06	1219.68	39058.28	0.9902	49.7901	74.9617	neg binomial	no	yes
WEST	MRIP	HB2013+LASURVEY	2007-2013; DROP 2010-2011						78.9368		normal	yes	NO
WEST	MRIP	HB2013+LASURVEY	2007-2013; DROP 2010-2011						79.4035	104.575	normal	no	NO
WEST	MRIP	HB2013+LASURVEY	2007-2013; DROP 2010-2011								neg binomial	yes	
WEST	MRIP	HB2013+LASURVEY	2007-2013; DROP 2010-2011								neg binomial	no	NO